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Anesthesiology complications in children

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Abstract

General anesthesia is defined by the American Society of Anesthesiologists as a "drug induced loss of consciousness during which patients are not arousable, even by painful stimulation". The perioperative period, immediately before, during, and after surgery, is a particularly critical time for pediatric patients. Even though anesthesia today is much safer than it has ever been, all anesthesia has an element of risk. General anesthesia has been safely given to children for many years. Improvements in inhalational and intravenous agents have increased the safety profile of general anesthesia and complication rates are low. General anesthesia has also allowed children to undergo painful or anxiety inducing procedures. General anesthesia is a complete loss of consciousness with amnesia, analgesia and neuromuscular blockade. It can be divided into three phases: induction, maintenance and emergence. Induction usually occurs with inhalational anesthetic in children until intravenous access occurs. Propofol, etomidate and ketamine are often used for induction. Maintenance of anesthesia occurs with inhalational or intravenous medications. Common inhalational anesthetics include nitrous oxide, sevoflurane or desflurane. Common intravenous medications used for maintenance are propofol and remifentanil. Typical complications in pediatric anesthesia are respiratory problems, medication errors, difficulties with the intravenous puncture and pulmonal aspiration. In the postoperative setting, nausea and vomiting, pain, and emergence delirium can be mentioned as typical complications. Side effects of anesthesia may include nausea, vomiting, drowsiness, muscle soreness and sore throat. Rare but more serious complications include adverse reactions that affect breathing, allergic reactions and irregular heart rhythms. Airway and respiratory events are the most common perioperative complications in pediatric patients. Several studies have reported on the incidence of pediatric airway-related complications. Consistently reported risk factors for serious airway complications include very young age and multiple intubation attempts. Laryngospasm was the most common cause of respiratory related arrests. Other etiologies included airway obstruction, difficult intubation, esophageal intubation, and aspiration.

Keywords: Anaesthesia; Complications; Intubation; Laryngospasm; Vomiting; Pain.

1. Introduction

The purpose of general anesthesia is to suppress the conscious perception and physiologic response to noxious stimuli and to render the patient unconscious. This is done through analgesia; decreasing pain, amnesia; blunting consciousness, akinesia; preventing movement, physiologic support; maintaining cardiovascular function, fluid management, electrolyte control, and thermoregulation and vigilance. Inhalation Respiratory and airway events accounted for 60 percent of all anesthesia-related complications and occurred in 3.1 percent of all anesthetics; laryngospasm occurred in 1.2 percent, bronchospasm in 1.2 percent, postoperative stridor in 0.7 percent, and aspiration in 0.1 percent of all anesthetics. The highest rates of airway and respiratory events occurred in neonates (<1 month old) and infants (<1 year old). Other risk factors for respiratory complications included history of prematurity and reactive airway disease. The risk factors for anesthetic mortality include neonates, age less than one year, American Society of Anesthesiologists (ASA) III and IV classification, children undergoing emergency surgery, general anesthesia and cardiac surgery. Airway management problems and cardiopulmonary events account for the majority of the cases of

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anesthesia related mortality in children with comorbidities. Though there can be inter-rater variability between these scores, they have been shown to correlate with perioperative complications and mortality. Pulmonary aspiration can be a devastating event although studies have shown that the incidence of aspiration in children is relatively low - two per 10,000 cases in elective procedures and 2.2 per 10,000 in emergency operations. Laryngospasm is common in pediatric surgical patients - twice the indicence when compared to adults. Studies have found that in children from birth to nine years of age the indcidence is 17 in 1000 cases. In children with obstructive lung disease or upper respiratory infections the risks can be up to 64 to 96 per 1000 cases. There is evidence to suggest that the use of supraglottic airway devices would decrease the incidence of laryngospasm. Postoperative apnea is more commonly seen in former preterm infants. All of the major societies, the American, European and Canadian Societies of Anesthesiologists agree on recommended preoperative fasting time prior to surgery. The recommendations include clear fluids until two hours before surgery, breast milk, without additives, up to four hours before surgery, infant formula: light meals; nonhuman milk up to six hours before surgery and high fat; fried foods; meat meals up to eight hours before surgery [1-14].

2. Anesthesiology drugs administered to children

Benzodiazepines induce hypnosis, anxiolysis, sedation, and amnesia and have anticonvulsant activity. In larger doses, they cause respiratory depression and apnea; they are synergistic with narcotics and barbiturates in their respiratory depressant effects. The most commonly used benzodiazepine in pediatric anesthesia is midazolam. Propofol has a very rapid onset and is associated with a reduced rate of postoperative nausea and vomiting. Propofol ranks as the most commonly used IV induction agent in pediatric anesthesia. Ketamine, which has a rapid onset and a short duration of action, causes central dissociation while providing analgesia and amnesia. Because ketamine increases the production of secretions, anticholinergic medications; atropine, glycopyrrolate, are usually needed. Dreams and hallucinations are the most common side effects associated with ketamine. Administration of a benzodiazepine concomitantly with ketamine decreases the incidence of dreams and hallucinations. Contraindications to the use of ketamine in children include the presence of an active upper respiratory tract infection, increased intracranial pressure, open globe injury, and the presence of psychiatric or seizure disorders. Opioids are widely used in the practice of pediatric anesthesia and pediatric perioperative medicine; they provide analgesia for painful procedures and decrease the incidence of postprocedural pain. Opioids suppress the carbon dioxide response, induce apnea, and are respiratory depressants, their use must be monitored closely, especially when they are administered with other respiratory depressing agents; inhalational anesthetics, barbiturates, benzodiazepines. Morphine and fentanyl are the most commonly used opioids in pediatric anesthesia. Morphine is a long-acting analgesic medication that provides effective analgesia. Because morphine can cause bronchospasm, secondary to histamine release, it should be used cautiously in children who suffer from asthma. Fentanyl, which is 80 to 100 times more potent than morphine, ranks as the most commonly used opioid in pediatric anesthesia. It has a shorter duration of activity and a more stable hemodynamic profile than morphine. Sufentanil, which is eight to 10 times more potent than fentanyl, is used primarily in pediatric cardiac cases. Remifentanil, which is similar in potency to fentanyl, is considered an ultrashort-acting opioid. It is used when anesthesia needs to be rapidly induced. Because the primary narcotic effect of remifentanil ends so quickly, additional analgesics must be used to provide postoperative pain relief. Alfentanil, which is five to 10 times less potent than fentanyl but has a faster onset of action, appears to have an increased incidence of muscle rigidity, convulsions, and prolonged respiratory depression compared with fentanyl and is therefore rarely used in pediatric anesthesia. Inhalational anesthetics have protective effects against ischemia-reper-fusion injury, and recent authors suggest that these effects may also result in clinically relevant improved organ function. This protective capacity has been related to a preconditioning effect, a postconditioning effect, and also to an effect on apoptosis. With the currently used volatile agents, Sevoflurane and Desflurane, anesthetic hepatotoxicity is no longer a significant clinical problem. Sevoflurane and Desflurane are contraindicated only in the very rare cases of malignant hyperthermia susceptibility. Sevoflurane is the ideal agent for inhalation induction of anesthesia in children because it is not irritating to the airway. Sevoflurane is a very effective bronchodilator, and, despite early controversial reports about nephrotoxicity by means of the production of Compound A, a degradation product resulting from the interaction of sevoflurane with the CO_2 absorbent soda lime, it is actually not at all toxic to the kidney as long as a fresh gas flow is kept at no less than 2 litres per minute. Desflurane is not suitable for inhalation induction due to its irritating effect on the airways, but we use it for the maintenance of anesthesia, after tracheal intubation, even in newborns. Desflurane is a bronchodilator and has a modest negative inotropic effect; it does not have any nephrotoxic effect. Nitrous oxide can inactivate vitamin B12, provoking neurologic disorders both in patients and in operating room personnel. We never use nitrous oxide. Toxic effects are particularly possible in persons with a subclinical, preexisting deficit of vitamin B12 but it is not possible to know in advance which patients are deprived of vitamin B12. Nitrous oxide also has the well-known effect of expanding any air-filled cavity. The neuromuscular blocking agents are used primarily as an adjunct to general anesthesia to facilitate endotracheal intubation and to maintain muscle relaxation during surgery. Neuromuscular blockers are the most useful drugs in our pharmacologic armamentarium but postanesthetic morbidity associated with incomplete reversal of neuromuscular blockers is still a frequent occurrence. Sugammadex, a relatively new drug, is a cyclodextrin that can form a very tight complex with rocuronium, less with vecuronium and pancuronium, thus allowing a reversal even during a profound neuromuscular block. Anesthesia can be both induced and maintained with either boluses or continuous infusions of IV anesthetic agents. IV anesthetic agents include barbiturates, opioid narcotics, benzodiazepines, and miscellaneous products; ketamine, propofol [15-23].

3. Adverse Events and Discussion

Assessment of anesthetic risk in children has been estimated by the American Society of Anesthesia risk assessment score. The ASA can help identify patients preoperatively that may be at higher risk for anesthetic complications and allow adjustment to the anesthetic plan for these higher risk children. Complications associated with general anesthesia can be divided into four basic categories: postoperative nausea and vomiting (PONV), oral trauma, thermoregulation issues and cardiorespiratory complications. An estimated 40% to 50% of children experience PONV after receiving general anesthesia.The serotonin antagonists; ondansetron, dolasetron, granisetron, are considered to be first line drugs for PONV. The insertion or removal of the endotrachael tube can irritate the throat, causing a sore throat and, or hoarseness. Craniofacial anomalies include cleft lip and palate, mandibular hypoplasia, the enlarged tongue seen with Beckwith-Wiedemann syndrome and many others. It is important to anticipate difficulty in mask ventilation as well as endotracheal intubation. The most common complications are respiratory and include airway obstruction, laryngospasm or bronchospasm, desaturation and apnea. Cardiovascular complications are rare in healthy children and include arrhythmias and hypotension. Longer procedures and higher anesthetic dose increase the risk of complications. Mechanical ventilation can be a source of complications, first of all pulmonary barotrauma and volutrauma. Usually we start mechanical ventilation with a very low tidal volume; then we slowly increase it until we observe the chest moving and hear gas entering the lungs with the stethoscope. We also check the monitor, looking for an acceptable capnographic curve and a peak inspiratory pressure in the airways no higher than 15–20 cm H_2O. Bronchospasm involves the constriction of the smooth muscle layers of the small airways. If left untreated, bronchospasm can progress to respiratory distress and ultimately, respiratory failure. Bronchospasm involves the constriction of the smooth muscle layers of the small airways. If left untreated, bronchospasm can progress to respiratory distress and ultimately, respiratory failure. This activity outlines the varying etiologies and clinical phenotypes, evaluation processes, and management strategies of bronchospasm. Additionally, the interdependent roles of the interprofessional team are highlighted in the care for pediatric patients with bronchospasm. Treatment of an acute asthma exacerbation targets the main components of the underlying pathophysiology: airway inflammation, smooth muscle constriction, edema, and mucus production. The standard initial therapy includes oxygen, intermittent dosing of a short acting beta 2 agonist; albuterol, an inhaled anticholinergic; ipratropium bromide, and corticosteroids. MH is an inherited disorder that is triggered by the volatile anesthetic agents and or succinylcholine. It usually occurs within the first two hours of anesthesia but can occur up to 24 hours later. MH is characterized by the development of a sudden and rapid high fever (38.5°C to 46°C, rising 1°C every five minutes), muscle rigidity, acidosis, and cardiac arrhythmias. Because MH can be fatal, aggressive therapy is warranted. The treatment of MH includes discontinuing all volatile inhalation agents, correction of the metabolic acidosis, and treatment with IV dantrolene: 2.5 mg/kg up to 10 mg/kg. Cardiorespiratory complications; respiratory depression, hypertension, arrhythmias, heart attacks, stroke, can also result from general anesthesia. Fortunately, these problems are extremely rare and are more likely related to surgical complications. The American Academy of Pediatrics Committee on Drugs (COD) notes that children tend to be particularly susceptible to oversedation with anesthesia. Incidence of perioperative anaphylaxis is estimated at 1 in 10–20,000 anesthetic procedures. It is noteworthy that in some cases bradycardia may be a life-protecting adaptive mechanism that allows the ventricle to fill despite hypovolemia. Then the treatment with atropine must be simultaneous with epinephrine and fluids; otherwise giving only atropine can result in cardiac arrest. As a matter of fact epinephrine and an expansion of intravascular volume are the key points in the perioperative management of anaphylaxis. The standard dose is 0.01–0.02 mg/Kg intravenously. Sometimes doctors are overzealous, using a high dosage due to their impatience in the treatment of an acute condition. According to recent reviews high doses can worsen a patient's post resuscitation hemodynamic condition by causing increased myocardial oxygen demand, ventricular ectopy, hypertension and myocardial necrosis. High doses do not improve survival and may be associated with a worse neurological outcome. Long term risks of general anesthesia have focused mainly on concerns for the effect of anesthesia on neurodevelopment in infants and children.

4. Conclusion

Minor events occur with variable frequency. The likelihood of these occurring is increased in patients under a year of age and in patients with an ASA status of 3 and above. Most events are respiratory in nature, emphasizing the importance of pulse oximetry and capnography as routine monitors in the delivery of anesthesia. Postoperative vomiting remains a common problem in older children.

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